EDUCATIONAL TECHNOLOGY FOR ENGINEERING EDUCATION

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Introduction:

Application, design, development, production and utilization are the characteristic tenets of any technology worth its salt. Educational technology seeks to apply the principles of psychology, sociology, communication, information and management in the process of education. From the micro-level national educational system it contributes to a feasible design for effective implementation. Educational development based on research is reflected in the areas of methodology, media and materials, evaluation, curriculum and learning resources. Productivity in education is a concept engineered by the evolution of educational technology; educational productivity in terms of qualitatively better human product eludes any scientific measurement but the same in terms of methods, media and materials can be subjected to scrutiny. The utilization of educational products refers to the effective use of process components resulting in an output of efficient human product. Thus, going through the mill of technological characteristics, educational technology emerges as a unique field synthesising three major concepts into a total approach viz. "the use of a broad range of resources for learning, the emphasis on individualized and personalized learning, and the use of the systems approach" (Ely , 1972)

2. Application Of Social Science-Concepts & Principles:

From behaviourism to cognitivism through gestaltism and humanism the approaches to human learning have varied focuses at various levels and times. It is generally accepted that behaviouristic principles contribute to skill development resulting in Training technology. Gestaltism has a holistic view of all human knowledge and contributes to an artistic trend rather than analytical techniques usually applied in sciences. Humanism has yielded student-centred approach to the teaching-learning process including the need for freedon to learn and individualized learning and personalized scheme of instruction.Cognitivism seeks to structure knowledge-disciplines and has yielded information technology and computerisation of educational process. Sociological and philosophical schools of thought have also contributed to the development of theories of learning and instruction. In the absence of any universally accepted theory of education applicable on all occasions at all levels in different societies for various periods, it is virtually a continuous process of perenial attempt to seek the truth or the discovery of special characteristics enabling mankind to pursue this unique process of life-long education, However, at micro-levels in classrooms, institutions, long and short courses such an application has yielded

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phenomenal successes which we have been enjoying these days. The latest trend of cognitivistic approach to human learning is therefore considered in this paper for application to higher education, in general, and engineering education, in particular.

Designing Educational Process :

From the macro-concept of education, it would be worthwhile to take up the micro-concept of instruction for purposes of design. Considerations of educational personnel are Curriculum design, instructional design, institutional design , and designing educational subsystems. The 'what', 'how', 'where' and 'in what context' of educational decisions are taken by these designs. The importance of curriculum design for a college teacher of current times is reflected in the policy of gradually spreading autonomy to all institutions of higher learning; the role of a teacher as a curriculum designer cannot therefore be relegated to the background. Subject matter, student or society as a database, specific competencies, process skills, humanistic conceptualisation and core curriculum are a few designs available to personnel in this area. The core of teachers functions is classroom instruction which needs to be desigined carefully to derive maximum benefits; evolution of a basic teaching model by Robert Glaser after observing a host of teacher performances sets a common design with the interlinkage between the stages of instructional objectives, entering behaviour, instructional methods and performance assessment with a feedback loop between them seeking to readjust at any stage of instruction considering the feedback from each stage as can be seen below:-

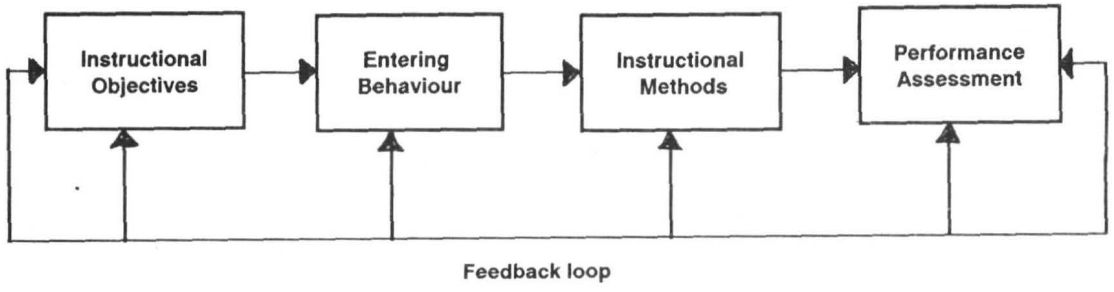


FIG.1. ROBERT GLASSER'S BASIC TEACHING MODEL.

Such a simple design cannot take care of all intricacies involved in higher learning. The usual input-process-output model needs to be considered from the intellectual skills involved at each stage. The input of new entrants into a course has immeasurable human potentials, varied learning styles, differeng psychological constructs and diverse backgrounds. The process part comprises methods, media and materials contributing to the operational efficiency to the optimum level in the entire system. There is a need to assess and control the quality of output which is again human marterial susceptible to wide variations in parameters to be considered; however, performance appraisal development system is being developed by educationists. Instructional designers have before them a long list of integrated models, task-oriented models, precriptive models, class focused models, product focused

models system-focouced models, organization-focused models, classroom/product models and comprehensive models and so no.

Engineering education as a subsystem of educational system with further subsystems within such as technican education and craftsman training incorporating institutional or organizational subsystems such as Universities, deemed Universities, autonomous colleges, Regional Engineering Colleges and other higher technical institutions offering different types of educational programmes at different levels such as U.G., P.G and reasearch courses, further incorporating subject-discipline subsystems of conventional areas of Civil, Mechanical, Electrical and Electronics Engineering besides special areas like Chemical, Metallurgical, Textile, Computer, and Printing and interdisciplinary areas such as environmental engineering, entrepreneurship and human resources development and management sciences. In this manner, identified educational areas function within one another as an integrated system design. Thus Instructional System Design (ISD) is included in the Educational System Design (ESD).

Development Of Educational Process:

Of all the stages in the process of education curriculum, instruction, media, materials, test developments are very important at the institutional level. Curriculum development is an important off-shoot of the application of educationaal technlogy. As most of the syllabi formulated for various courses are more or less handed down traditionally with some replacements or other, not necessarily to the extent of modification, there is a vital need to apply the technological tenets in this primary development for any course of education. Instructional development emphasises the selection of method of instruction to suit the nature of the subject, the subject abilities, and the objectives. The following figure relates instructional methods to objectives:

Method / Aim	Lec-ture	Small Group Discu-sion	Lab/ Work shop	Text mate-rial	Video tape	A.V. aids	Broad-cast & tele-cast	CAL	Tele Con-fere-ncing	Home kit	Dial acc-ess	Pro-jects	As-sign-ments	Self-help
Attitudes	ooo	●●			oo		ooo ooo		●●●	+ + +		+ + + + + +		+ + + + + +
Skills		●●●	●●●		ooo				●●	+ + +		●●	●●● ●●	+
Know-ledge	ooo ooo	●●●		ooo ooo	ooo ooo	ooo	oo	+ + +	***	+ + +				
Under-standing	o	●●● ●●●	+ + + +	ooo o	ooo o	ooo	oo		●●●	+ + +	ooo			
Techni-ques	o	●●● ●●●	+ + + +	ooo	o	ooo o	+	+ + + + +	*			+	●●● ●●●	
Anal-ysis	o	●●● ●●●		ooo	o	oo		+	●●●		o + +			
Syn-thesis		●●● ●		o	o		o	+ + +	●			●● + + + +	●●● ●●●	
Manual			ooo ooo		ooo o		oo			+		+		

o Teacher-oriented teaching
+ Student-initiated learning

Table.1. Objectives-Methods Matrix

The subjects of teaching get classified according to the structure of knowledge forming the subject.

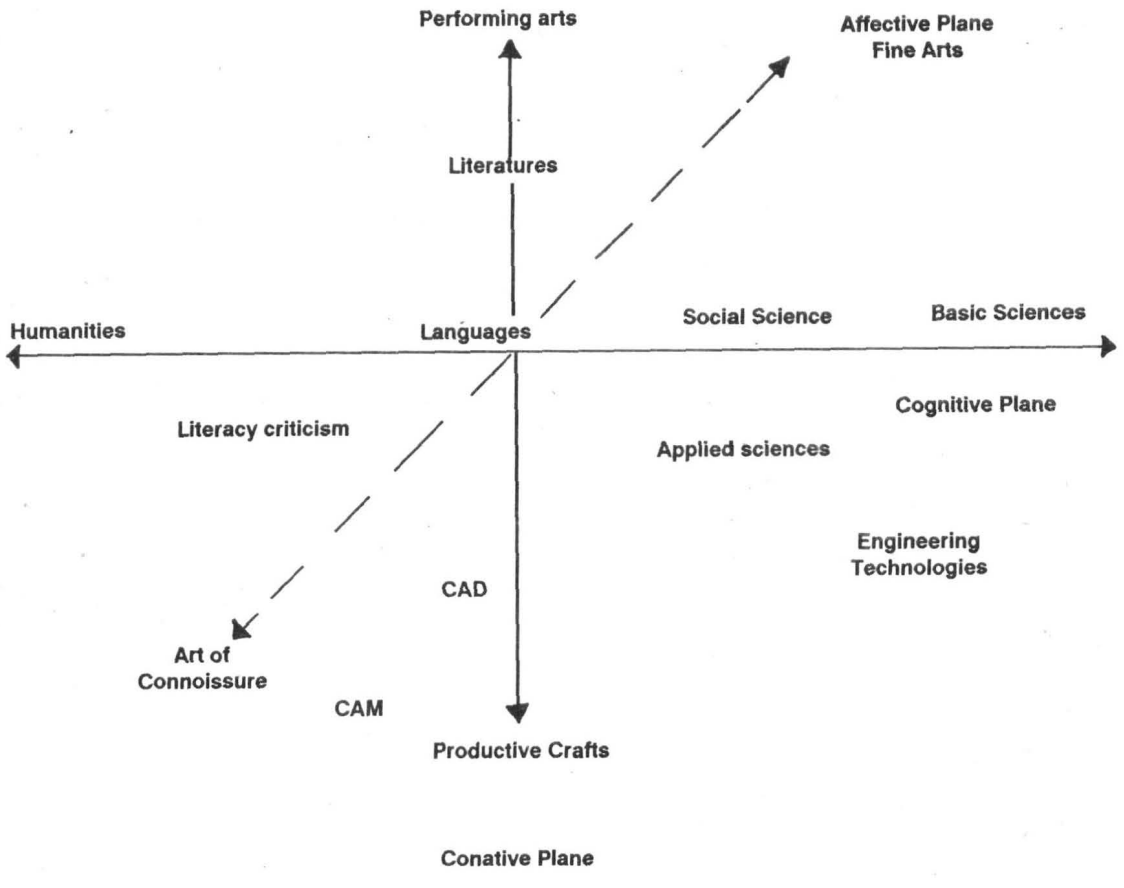


FIG.2. CLASSIFICATION OF KNOWLEDGE-DISCIPLINES

A sort of relationship between the method-matrix of the previous figure and the 3-D structure in this figure is not difficult to be established to develop an appropriate instructional method to teach a chosen subject. However, finer details are to be worked out. Media usually supplement the methods as can be seen in the matrix and hence need to be developed following the criteria evolved from the above relationship. Material development is an essential step for successful instruction. Textbooks to Assignments, there are several types of materials usually grouped as Learning resources. In a good institution it is a must to establish Curriculum Development Centers and Learning Resource Development Centers. The development of a variety of tests ranging from quiz to blue-printed examination question paper is integral part of educational development. Teacher made tests are used as a means of

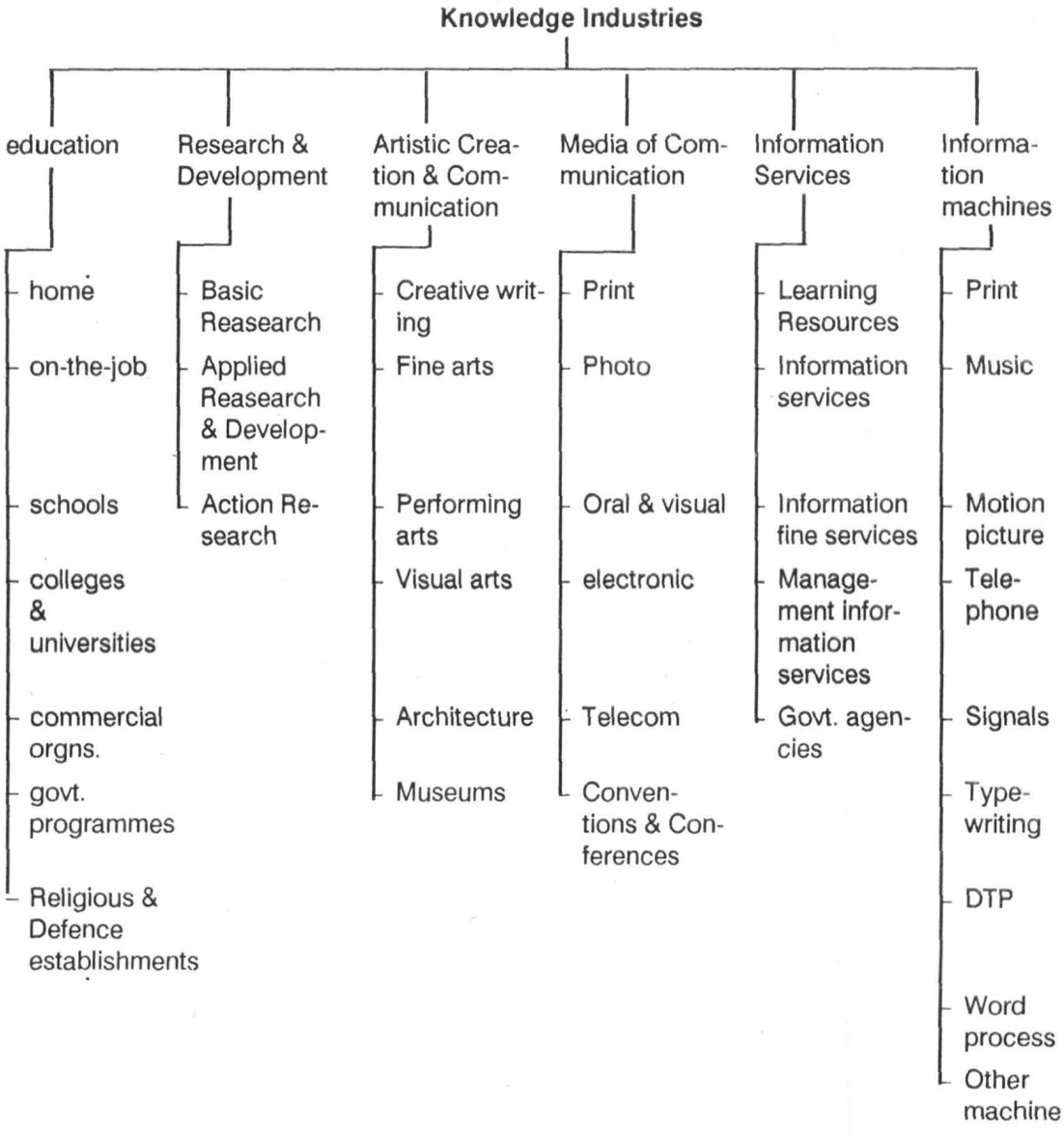
evaluating teaching process whereas standardized tests are the need for objective-related measurement. However it is now becoming a reality with the establishment of NTS that at all levels scientific testing techniques need to be developed for measuring the learning outcomes. Criterion-referenced testing yieds place to norm-referenced testing. Computerised test construction is viewed as an authentic objective evaluation in education.

Production In Education

Educatrional productivity is more a qualitative concept than a quantitatively measurable one.

$$EP = \frac{OP - IP}{TP}$$

The output being end-of-the-process student quality, input being entry-level student knowledge, skills and attitude and through put being the instructional development practices, comprising methods, media materials and teacher quality; besides institutional environs and facilities, educational productivity depends upon the production of all these components. Development of Selection and admission criteria at the beginning of a course, selection of appropriate instructional method to relate the student level to the learning objective through the subject structure, selection and production of media for use in the course of instruction, production of materials for instructional purposes and production tests for use at different levels and stages of instruction are important in educational production. Of course, the attendant features of any production process starting from specifications and prototype to pilot test and massproduction are applicable to educational development, too. Depending on the student strengths, large class instruction or individualized instruction influences the production procedures, too. Such knowledge organization and knowledge use has necessitated the establishment of what may be termed as knowledge industries and knowledge occupations.



Accordingly knowledge occupations also develop as

- transporters
- transformers
- routine processers
- discretionary processors
- managerial processors
- interpreters
- analyzers
- knowledge creators

Utility In Education:

Knowledge utilization refers to "understanding and improving the utilization of scientific and professional knowledge in settings of public policy and professional practice". The following four propositions are put forward:

- Knowledge use is interpretive
- Knowledge use is socially constrained
- Knowledge use is systematic
- Knowledge use is transactive

Educational technology takes care of these four directions in the utilization of knowledge by adopting one or other of the seven approaches:

- Knowledge-driven (thirst for learning)
- problem-solving (facing life's challanges)
- interactive (R & D process)
- enlightenment (Policy-making)
- political (evaluative reasearch to legitimate a decisions)
- tactical (earlier decisions delayed)
- research-oriented (value of enquiry)

There are several models available to study the diffusion process in educational utilization; Research, Development and Diffusion, Social Interaction, Problemsolver, Linkage, Comrehensive and Planned Diffusion. Applying one or other model for diffusion of educational information borne out of thinking, practice or R & D the ultimate goal of education in a continual social change process is achieved.

The matrix (Table 2) applies educational technology in engineering education to make effective use of all traits of technology engendered in all aspects education at institutional level. At marco-level too such a matrix making is possible for planning, organizing, coordinating, supervising, monitoring and utilizing engineering education in national development.

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Educational Aspects → / Technological traits ↓	Engg. Curriculum	Engg. Institutions	Engg. Instruction				Professional contribution
			methods	Media	Materials	Evaluation	
Application of Educational theories	Congnitivism	Institutional Morale on organic growth	Interactive techniques	Creativity	Trigger type not spoonfed	Integeral to learning	Medium is the message
Design	Structure of knowledge Disciplines	Paragamatic considerations	Freedom to learn	Multimedia utilization	Innovative for utilization	Formative rather than summative	Entrepreneurial
Development	Inter-disciplinary approach	Continuous feedback & inputs	Learning how to learn	self learning	PL, CAI,SLM	Real life situations	Constant in Communication
Production	Telescopic levels with multiple entry and exist points	Institutional Excellence	Eclectic method	Variety of modes	Institution based	Individualistic	Social needs fulfilment
Utilisation	Periodic revision on suitable evaluation	Integrated national progress	Tripartite contract between students, Teachers & system	One's own pace and choice	Effective & Efficient	Accreditation	Wide range from broad based to specialized

Table 2. Educational Engineering Matrix.